

ABSTRACT

Reliable, flaw-tolerant brittle materials are produced by incorporating layers under residual compression on the surface and throughout the bulk of the material that act to trap and contain the propagation of otherwise catastrophic cracking. The residual compression within these layers acts to reduce the stress intensity of the cracks, thereby causing them to arrest until further loading is provided. This highly desirable stable, subcritical crack growth mode persists with increased loading until the applied stress is large enough to drive the crack completely through compressive region, after which failure occurs. The exact level of stress needed to accomplish this is dictated by the architectural design of the compressive layers such that the material can be designed to have any minimum strength desired, within the limits of the materials system used. This results in a truncation of the strength distribution, such that there is virtually zero probability of failure below this minimum value, i.e. the material possesses a *threshold strength*. Consequently, sensitivity to flaws that would ordinarily cause catastrophic failure at stresses below the threshold strength is eliminated. Furthermore, the potential exists for the complete elimination of the strength variability, hence improving reliability, through the creation of nearly deterministic, i.e. single-valued, strengths by increasing the threshold strength above the stresses at which failure normally initiates from intrinsic flaws.